ORIGINAL ARTICLE

Immediate effects of 850 nm Diode Laser on patients with Cervical Myofascial Pain Syndrome: a Randomized-controlled trial

Ahmed Ali Zahreldin Ali, PhD [1], Mahmoud S. ElBasiouny, PhD [2], Mona Ibrahim Morsy, PhD [3], Hagar S. Abouamra, BSc [4], Shorouk Elshennawy, PhD [5,6]

ABSTRACT

Objectives

Myofascial pain syndrome (MPS) is one of the most common causes of chronic neck pain. Low level laser therapy (LLLT) is a physical therapy modality that can be used to reduce pain and improve function of patients with MPS. The aim of this study was to assess and evaluate the effects of LLLT added to the conventional physical therapy in comparison with the conventional physical therapy alone on pain intensity, pressure pain threshold (PPT) and cervical range of motion (ROM) in cervical MPS patients.

Methods and Materials

Twenty-four adults diagnosed with cervical MPS according to Travell and Simons' criteria were randomized into 2 equal groups; Group A: receive LLLT on upper trapezius trigger points with conventional physical therapy, while Group B: receive conventional physical therapy alone. Measured outcomes were pain, PPT and cervical flexion and extension ROM, using Numerical Rating Scale (NRS), Algometer and Goniometer, respectively. Outcomes were measured pre-treatment and immediately post-treatment.

Results and Discussion

A significant improvement in the pain, PPT and cervical flexion and extension were observed in all groups after treatment, compared to the pre-treatment values ($P < .05$). However, there was no significant difference between the study groups post treatment for all measured outcomes.

Conclusion

Low-level laser therapy is not considered a beneficial extension to the standard conventional therapy on active MPS as it didn't add to the immediate effect of conventional physical therapy on pain, PPT and ROM in patients with cervical MPS.

Keywords

Myofascial pain syndrome; trigger point, laser therapy; LLLT; conventional therapy; RCT.

INTRODUCTION

Myofascial pain syndrome (MPS), which is linked to certain trigger points (TrPs), is one of the most prevalent chronic, non-articular, musculoskeletal causes of neck pain. TrPs are most frequently identified in the upper trapezius and infraspinatus muscles.[1] Tender points inside the tight muscle band are triggered and produced by excessive tension, pressure, or

1. Ahmed Ali Zahreldin Ali, Department of Medical Laser Applications, National Institute of Laser Enhanced Sciences, Cairo University- Egypt
2. Mahmoud S. ElBasiouny, Professor of General and Plastic Surgery, National Institute of Laser Enhanced Sciences, Cairo University- Egypt
3. Mona Ibrahim Morsy, Professor of Photobiology, National Institute of Laser Enhanced Sciences, Cairo University- Egypt
4. Hagar S. Abouamra, Demonstrator of Anatomy, Faculty of Medicine, Cairo University- Egypt
5. Shorouk Elshennawy, Professor of Physical Therapy for Pediatrics, Faculty of Physical Therapy, Cairo University- Egypt and Professor of Physical Therapy for Pediatrics, Faculty of Physical Therapy, Misr University for Science and Technology- Egypt

Correspondence

Ahmed Ali Zahreldin Ali, PhD. in Medical Applications of Lasers in Physical Therapy, National Institute of Laser Enhanced Sciences, Cairo University, Egypt.
E-mail: ahmed_zahreldin@stud.cu.edu.eg

Bangladesh Journal of Medical Science Vol. 23 No. 02 April'24

DOI: https://doi.org/10.3329/bjms.v23i2.72142

contraction, which causes referred pain.[2] Uncertainty exists regarding the precise mechanism that led to MPS development. According to one theory, TrPs are brought on by abnormal electrical activity in the connective tissue surrounding the neuromuscular junction and the neuromuscular junction itself.[3] Additionally, the Integrated Trigger Hypothesis postulates that repeated micro trauma causes a "energy crisis" with excessive Acetyl choline release, increasing the metabolic demands on the muscle and impairing circulation, which ultimately results in the formation of TrPs.[4]

Different methods, including massage, acupuncture, electrotherapy, local injections, exercise, and laser therapy programmes, were frequently implemented to control MPS.[5]

A light-based method called low-level laser therapy (LLLT) is used for relieving pain and neurological diseases, reduce inflammation and edoema, and speed up the healing of deeper tissues and wounds.[6] With more ATP created and less reactive oxygen species available as a result of the mitochondria's absorption of photons, transcription factors are activated. [7] 7 As a result, it is regarded as a relatively novel physical therapy technique that has the potential to reduce discomfort and, as a result, enhance function in a variety of musculoskeletal problems.

By lowering muscle arteriole spasm and oxidative stress, laser therapy can enhance tissue oxygenation and lessen muscular fatigue.[8] The LLLT may boost endogenous endorphin production and lower pro-inflammatory neuropeptides such substance P, hence lowering pain.[9] The action of LLLT on the sodium-potassium pump changed nerve excitation and conduction, which decreased pain perception.[10]

The results of a previous systematic review, which employed LLLT for 2-4 weeks and included five studies in the meta-analysis to examine the effectiveness of the therapy in reducing pain in patients with cervical MPS, were in favour of LLLT.[11] Another systematic review found a conflicting evidence for the benefit of LLLT in improving pain immediately and in short-term in chronic MPS patients.[12]

Therefore, the objective of this randomized controlled trial was to assess and evaluate the immediate effects of LLLT added to the conventional physical therapy in comparison with the conventional physical therapy alone on intensity of pain, pressure pain threshold (PPT) and neck range of motion (ROM) in patients with cervical MPS.

Material and methods

Study design

This was a randomized clinical trial, applying the Consolidated Standards of Reporting Trials guidelines (CONSORT).[13] It was registered on PACTR with registration number PACTR202306638021904.

Randomization sequence was generated using a block randomization website,[14] with bock size= 6 to assign the participants in two equal parallel groups with allocation ratio 1:1. Randomization and allocation were done by an independent person, not involved in the study. After each participant satisfied the eligibility criteria and consented to participate; they were assigned to one of these two groups, as shown in **(Figure 1)**:

Group A: Laser therapy group, which received LLLT in addition to the conventional physical therapy program.

Group B: Control group, which received the conventional physical therapy program alone.

The participants, investigator and assessor were not blinded, because of the nature of the interventions. The principle investigator performed the interventions and assessment.

Study population

Twenty-four cervical myofascial pain syndrome male patients participated in this study. They were selected from private physical therapy clinic. Participants were chosen based on the following criteria for inclusion:

Adults; over 18 years old.

Diagnosis of MPS in accordance with Travell and Simons' criteria. For a diagnosis, there had to be five major criteria and at least one minor criterion. Regional pain, referred pain, a taut band, a tender point in the band, and a limited range of motion are the major criteria. Minor criteria include; complaints of a local twitch response, pain that are triggered by pressure on the tender spot, and pain alleviation with injections or stretching.[15]

Had active and palpable TrPs that cause pain and/or referred pain by pressure either on one side of the upper trapezius muscle or both sides, with pain duration less than one week.

Exclusion criteria were; fractures or open wound, other neuro-musculo-skeletal disorders causes neck pain such

as fibromyalgia, cervical disc lesion, radiculopathy or myelopathy, other systemic diseases, previous surgical procedures, or recent trigger point injection.

Study interventions

1. Low Level Laser Therapy:

Laser therapy group received LLLT on the affected side of neck and shoulder. It was performed using LLLT device (INTELECT® NEO THERAPY SYSTEM, 6001-INT, Chattanooga) with the parameters shown in **(Table 1)**. After eye protection, skin cleaning and stretching; laser therapy was done by placing the probe to the affected upper trapezius muscle with little pressure over the trigger points.

2. Conventional Physical Therapy:

Group A and B individuals were all given a conventional physical therapy program for neck and shoulder pain lasted for 30 minutes, which included; ultrasound therapy (US) for 5 min (continuous mode, 2 W/cm^2, 1 MHz) followed by hot packs and transcutaneous electrical nerve stimulation (TENS) for 15 min and finally 10 minutes of stretching and isometric exercises for neck and shoulder.

Measured outcome

All participants had pre-treatment and post-treatment evaluation, to determine the immediate effects of the laser and conventional therapies. Pain intensity, pressure pain threshold, and range of motion were all outcomes that were measured.

- *Pain:*

The Numerical Rating Scale (NRS), an 11-point numeric scale with a range from 0 (no pain) to 10 (the most agonizing pain imaginable), was used to measure pain and the patients were asked to report the average pain intensity.

- *Pressure pain threshold (PPT):*

The upper trapezius muscle's tenderness and pressure pain threshold, which is the lowest pressure (kg/cm2) that causes pain or discomfort, were tested using the WANGER force dial. The participants sat erect in chairs with their feet flat on the floor, hands on their legs, and backs fully supported. The myofascial trigger points in the upper trapezius muscle were precisely located on the force gauge's rubber disk, which had a surface area of 1 cm2. Gradual compression was then administered at a rate of roughly 0.5 kg/cm2/s, perpendicular to the upper trapezius muscle fibers. The participant's pain threshold was reached by gradually increasing the pressure, and the pressure was measured in kg/cm2 at that point. Measurements were made three times, each at a 60-second interval, and the mean value was determined.

- Cervical range of motion:

Goniometer was used to assess the active range of motion (ROM) of the cervical joint in flexion and extension. The participants were sitting with thoracic and lumbar spine well supported by the back of the chair, and shoulder girdle was stabilized. Goniometer was over the external auditory meatus, the stationary arm aligned perpendicular to the floor and the moving arm to the base of the nose. The participants were instructed to perform cervical flexion and extension with the maximum active range of motion and the readings of the goniometer were recorded at each extreme of the motion.

Statistical analysis

Version 26 of SPSS for Windows (SPSS, Inc., Chicago, IL) was used for the statistical analysis. The pain, PPT, and ROM values in all groups had normal distributions and did not violate the parametric assumption, according to descriptive analysis, mean (standard deviation), histograms with the normal distribution curve, and the Shapiro-Wilk test for data normality. To compare the variables at various measuring intervals (within group), the Paired-Samples T test was utilized. While, between subjects factor which had two levels (Laser therapy and Control groups) was assessed using Independent-Samples T Test. Alpha level was 0.05. Analysis was done as if each subject received the treatment or control condition as planned.

ETHICAL CONSIDERATIONS

This RCT was conducted under the guidelines and the approval of Ethics Committee of the National Institute of Laser Enhanced Sciences (NILES), Cairo University. All participants completed a consent form authorizing their participation after being informed of the study methodology prior to their involvement.

RESULTS

The mean and standard deviation of subjects' age in both groups were 37.42 (13.6) and 33.92 (5.6) for

Laser therapy and Control groups, respectively with no statistically difference between groups at baseline ($P > 0.05$), as shown in **(Table 2)**. MPS were 3 on the right and 9 on the left in the Laser therapy group, compared to 5 on the right and 7 on the left in the Control group.

Table (1): LLLT parameters:

Laser type	GaAlAs Diode, CW
Wavelength	850 nm
Treatment time per point	70 sec (total around 6 min)
Output power	100 mW
Energy density	8.9 J/cm^2
Spot size	0.5 cm^2
Points	on the trigger point (maximum 5 points)
Probe	directly, stationary, perpendicular and slightly contacting the skin of participants during the treatment process

Within group comparison of intensity of pain, PPT and cervical flexion and extension ROM showed statistically significant within each group post treatment ($P < 0.05$), **(Table 2)**.

Between groups comparison showed no statistically significant difference between mean values of intensity of pain, PPT and cervical flexion and extension ROM measurement between the study groups after treatment ($P = 0.404$, 0.903, 0.95 and 0.066) for each measured outcome, respectively, **(Table 2)**.

Table 2: Comparison between Mean (SD) values of outcome measured variables before and after treatment within and between groups:

		Laser therapy Group (n= 12) Mean (SD)	Control Group (n= 12) Mean (SD)	*P*-value
Pain	Before Treatment	5.92 (2.2)	5.92 (1.6)	1
	After Treatment	2.92 (1.9)	2.25 (1.9)	0.404
	P-value	< 0. 001	< 0. 001	
PPT	Before Treatment	57.08 (17.2)	48.33 (21.5)	0.283
	After Treatment	76.25 (15.5)	75.42 (17.6)	0.903
	P-value	< 0. 001	0. 001	
Flexion	Before Treatment	52.96 (6.7)	51.67 (11.9)	0.747
	After Treatment	57.67 (6.5)	57.92 (12)	0.95
	P-value	0.008	0.007	
Extension	Before Treatment	67.67 (6.5)	74.17 (4.7)	0.01
	After Treatment	72.17 (7)	77.08 (5.4)	0.066
	P-value	0. 002	0.027	

Notes: * = significant at $P < 0.05$.

DISCUSSION

In this study, 30 min of conventional physical therapy program for neck and shoulder (US, hot packs, TENS, and stretching and isometric exercises) significantly improve the symptoms (pain, PPT and cervical ROM) immediately in patients with MPS (active trigger points) without any significant difference after adding LLLT (850 nm – 100 mW) to the conventional therapy.

In a prior study, [16] the immediate efficacy of LLLT applied to trigger points for cervical MPS patients was evaluated. It was found that the 810 nm Ga-Al-As laser, which has a maximum power output of 150 mW, is more effective than a sham laser at providing pain relief.[16] The laser therapy has immediate analgesic effects as it decreases mitochondrial membrane potential in the dorsal root ganglion neurons that leading to neural blockage.[17] Within 15 minutes of application, LLLT reduces trigger point tenderness, which is a clinical finding that may be explained by suppression of transmission at the neuromuscular junction.[18]

However, in the present study, the effect of laser therapy could be covered by the other modalities used or it is not a beneficial extension to the standard conventional therapy. To increase physiologic functioning and exercise tolerance, it is crucial to use multimodal treatment plans in rehabilitation; this makes it challenging to assess the independent value of a certain modality on its own.[12] Multimodal treatment approaches with exercise, modalities, and education may help MPS

symptoms, according to Barbero et al.[19] Additionally, Rickards came to the conclusion that TENS, a quick-fix painkiller, and laser, a short-term remedy, could both help myofascial trigger patients.[20] Previous randomized trials assessed the immediate effects of hot packs combined with ultrasonography [21] and revealed that the TrPs significantly improved when TENS was used in conjunction with heated packs, myofascial release, and active ROM exercises. [22] Exercise has also been shown to reduce the severity of myofascial pain in individuals, and it seems that combining stretching and strengthening activities has the greatest benefit.[5] The used modalities in the current conventional therapy program are effective, separately or combined, according to the previously mentioned references, and so the effect of LLLT as a stand-alone modality should be further assessed.

Numerous RCTs have reported contradictory results for LLLT application to manage MPS. Among these studies, two studies used 904 nm laser, compared the effect of LLLT (18 J per session, 600 seconds) with US as a stand-alone therapies and with placeboes [23] or compared LLLT (74mJ/cm2, 30sec) with US and with ischemic compression.[24] After applying the interventions for 2 weeks Manca et al. concluded that the use of laser therapy or US as a stand-alone therapies could induce a rapid response to pain relief, PPT and cervical ROM, however, there were no differences seen between the treatment groups and placebo groups.[23] On the other hand, Kannan revealed significant improvement in pain, provocative pain and cervical ROM among all 3 groups with a significant improvement favoring the laser groups after 5 days.[24] Dundar et al. compared 830-nm laser therapy (7 J, 2 min) with placebo added to daily isometric and stretching exercises and detected significant improvements in pain, ROM and the neck disability index after 4 weeksand the results showed that, between the two groups, no differences that could be considered significant were found.[25] Another study found that; patients with lateral epicondylitis gain significantly more with cyriax physiotherapy combined with low level laser therapy than from cyriax physiotherapy alone during a three-week period. [26] It is evident from these studies that the optimal effective parameters of LLLT for MPS were not yet known. There are a wide range of LLLT protocols with different parameters, wavelengths, powers, doses, duration and depth of the trigger points, which could attribute to these differences in laser therapy effectiveness.

Limitations and recommendations:

The present study's limitations included the small number of the sample and the study's exclusivity to men. Besides, the needs to compare both interventions to placebo and other interventions to determine the effectiveness of the interventions, overcome the placebo effects and serve as a baseline. In addition, no evidence of standardized LLLT regimens for patients of cervical MPS was available.

Therefore, larger randomized placebo-controlled trials that evaluating laser as a stand-alone therapy are recommended. In addition, comparing different treatment regimens with each other to reach the most effective and appropriate protocol. Furthermore, using more objective assessment of the outcomes is needed.

CONCLUSION

Adding Low-level laser therapy to the conventional physical therapy had a equivalent immediate impact on pain relief, pressure pain threshold decrease, and cervical range of motion improvement as conventional physical therapy alone, among the patients of cervical myofascial pain syndrome, with no significant difference between them. Laser therapy is not considered a beneficial extension to the standard conventional therapy and its effectiveness as a stand-alone therapy should be confirmed by additional randomized controlled trials for longer duration.

Source of Fund: Nil

Conflicting Interest: Nil

Acknowledgement: Nil

Ethical Clearance: Yes

Consent for Publication

All authors reviewed and approved the final version and have agreed to be accountable for all aspects of the work, including any accuracy or integrity issues.

Disclosure

The author declares that they do not have any financial involvement or affiliations with any organization,

association, or entity directly or indirectly with the subject matter or materials presented in this article. This includes honoraria, expert testimony, employment, ownership of stocks or options, patents or grants received or pending, or royalties.

Funding

This study received no funding.

Data Availability

Information is taken from freely available sources for this editorial.

Authorship Contribution

All authors contributed significantly to the work, whether in the conception, design, utilization, collection, analysis, and interpretation of data or all these areas. They also participated in the article's drafting, revision, or critical review, gave their final approval for the version that would be published, decided on the journal to which the paper would be submitted, and made the responsible decision to be held accountable for all aspects of the work.

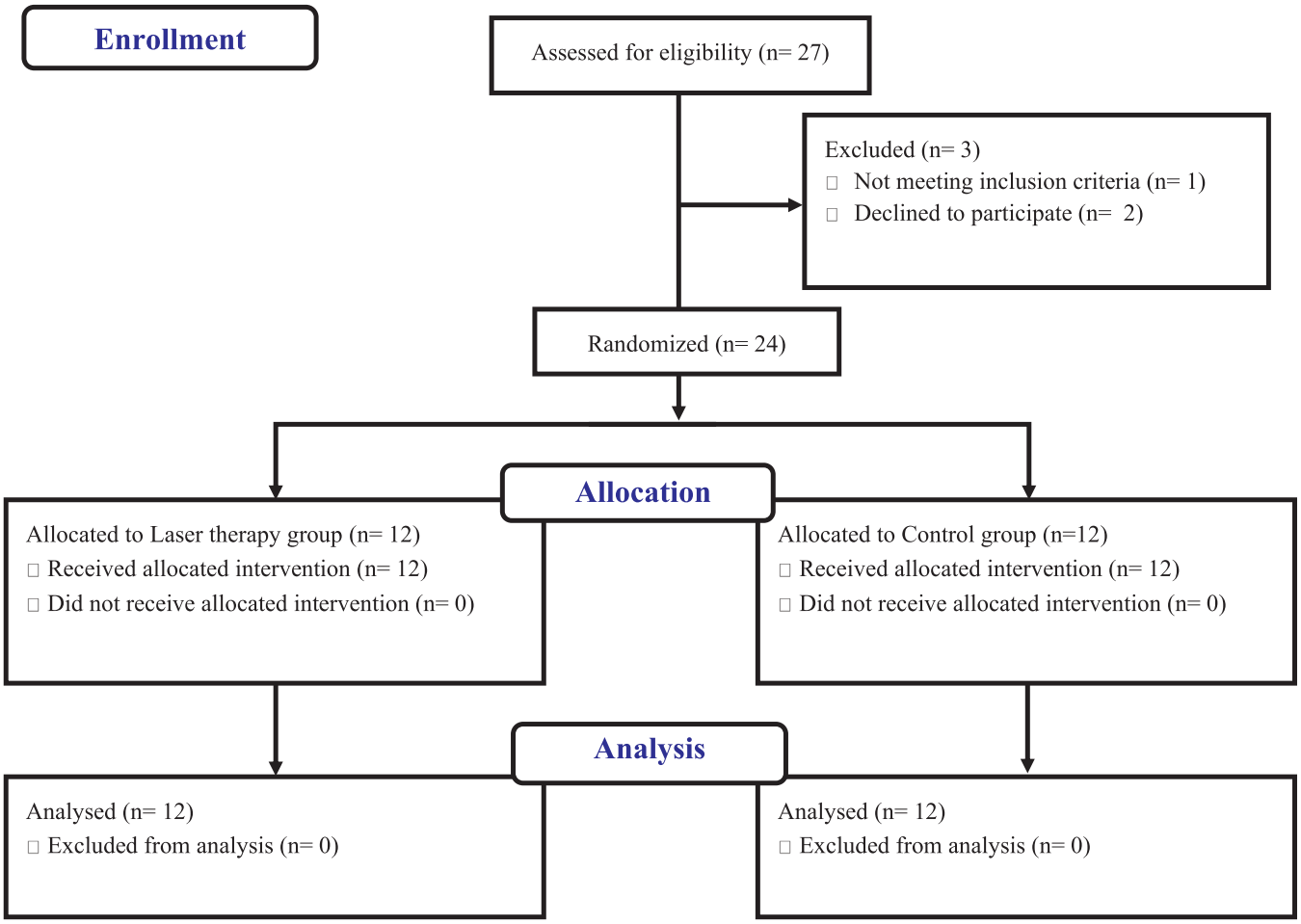

Figure 1: CONSORT flow chart:

References

1. Akhbari B, Salavati M, Ebarahimi I, Ezzati K, Khah HH. Association of Ultrasonography Findings with Pain Range of Motion Disability and Pressure Pain Threshold in Subjects with Upper Trapezius Myofascial Pain Syndrome - Physical Treatments - *Specific Physical Therapy Journal* [Internet]. Physical Treatments - *Specific Physical Therapy Journal.* 2015 [cited 2022 Jul 25]. p. 221–7. Available from: https://ptj.uswr.ac.ir/article-1-202-en.html
2. Salavati M, Akhbari B, Ebrahimi Takamjani I, Ezzati K, Haghighatkhah H. Reliability of the Upper Trapezius Muscle and Fascia Thickness and Strain Ratio Measures by Ultrasonography and Sonoelastography in Participants With Myofascial Pain Syndrome. *J Chiropr Med [Internet].* 2017 [cited 2022 Jul 25;**16**(4):316–23. Available from: https://pubmed.ncbi.nlm.nih.gov/29276464/
3. Urits I, Charipova K, Gress K, Schaaf AL, Gupta S, Kiernan HC, et al. Treatment and management of myofascial pain syndrome. *Best Pract Res Clin Anaesthesiol.* 2020;**34**(3):427–48.
4. Shah JP, Gilliams EA. Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome. *J Bodyw Mov Ther [Internet]*. 2008 [cited 2023 Mar 1];**12**(4):371–84. Available from: https://pubmed.ncbi.nlm.nih.gov/19083696/
5. Mata Diz JB, de Souza JRLM, Leopoldino AAO, Oliveira VC. Exercise, especially combined stretching and strengthening exercise, reduces myofascial pain: a systematic review. *J Physiother*. 2017;**63**(1):17–22.
6. Chung H, Dai T, Sharma SK, Huang YY, Carroll JD, Hamblin MR. The nuts and bolts of low-level laser (light) therapy. *Ann Biomed Eng [Internet]*. 2012 [cited 2022 Jul 25];**40**(2):516–33. Available from: https://pubmed.ncbi.nlm.nih.gov/22045511/
7. Farivar S, Malekshahabi T, Shiari R. Biological Effects of Low Level Laser Therapy. *J Lasers Med Sci [Internet]*. 2014 [cited 2022 Jul 25];**5**(2):58. Available from: /pmc/articles/PMC4291815/
8. Ahmed H, Jarrar MA, Ahmed R, Alqhtani R, Alshahrani A. Effect of Post-Isometric Relaxation and Laser on Upper Trapezius Trigger Point Pain in Patients with Mechanical Neck Pain. *Niger J Clin Pract [Internet].* 2020 [cited 2022 Jul 25];**23**(12):1660–6. Available from: https://pubmed.ncbi.nlm.nih.gov/33355818/
9. Cotler HB, Chow RT, Hamblin MR, Carroll J. The Use of Low Level Laser Therapy (LLLT) For Musculoskeletal Pain. *MOJ Orthop Rheumatol [Internet]*. 2015 [cited 2022 Jul 25];2(5). Available from: /pmc/articles/PMC4743666/
10. Tripathi T, Ganesh G, Rai P. Pain Pathways and Effect of Low Level Laser Therapy on Pain During Fixed Orthodontic Treatment-an Overview. *Eur J Dent Med.* 2015;**8**(1–3):1–5.
11. Kadhim-Saleh A, Maganti H, Ghert M, Singh S, Farrokhyar F. Is low-level laser therapy in relieving neck pain effective? Systematic review and meta-analysis. *Rheumatol Int [Internet]*. 2013 [cited 2022 Jul 14];**33**(10):2493–501. Available from: https://pubmed.ncbi.nlm.nih.gov/23579335/
12. Gross AR, Dziengo S, Boers O, Goldsmith CH, Graham N, Lilge L, et al. Low Level Laser Therapy (LLLT) for Neck Pain: A Systematic Review and Meta-Regression. *Open Orthop J*. 2013;**7**(1):396–419.
13. Schulz KF, Altman DG, Moher D. CONSORT 2010 Statement: Updated guidelines for reporting parallel group randomised trials. *J Clin Epidemiol [Internet].* 2010 [cited 2022 Jul 25];**63**(8):834–40. Available from: https://pubmed.ncbi.nlm.nih.gov/20346629/
14. Simple randomisation service | Sealed Envelope [Internet]. [cited 2022 Jul 25]. Available from: https://www.sealedenvelope.com/simple-randomiser/v1/
15. APPENDIX MYOFASCIAL PAIN SYNDROMES DUE TO TRIGGER POINTS - Pain and Disability - NCBI Bookshelf [Internet]. [cited 2022 Jul 25]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK219241/
16. Chang WH, Tu LW, Pei YC, Chen CK, Wang SH, Wong AM. Comparison of the effects between lasers applied to myofascial trigger points and to classical acupoints for patients with cervical myofascial pain syndrome. *Biomed J* [Internet]. 2021 [cited 2022 Jul 25];**44**(6):739–47. Available from: https://pubmed.ncbi.nlm.nih.gov/35166212/
17. Takenori A, Ikuhiro M, Shogo U, Hiroe K, Junji S, Yasutaka T, et al. Immediate pain relief effect of low level laser therapy for sports injuries: Randomized, double-blind placebo clinical trial. *J Sci Med Sport [Internet].* 2016 [cited 2022 Jul 25];**19**(12):980–3. Available from: https://pubmed.ncbi.nlm.nih.gov/27034111/
18. Chow RT, Johnson MI, Lopes-Martins RA, Bjordal JM. Efficacy of low-level laser therapy in the management of neck pain: a systematic review and meta-analysis of randomised placebo or active-treatment controlled trials. *Lancet*. 2009;3**74**(9705):1897–908.
19. Barbero M, Schneebeli A, Koetsier E, Maino P. Myofascial pain syndrome and trigger points: Evaluation and treatment in patients with musculoskeletal pain. *Curr Opin Support Palliat Care*. 2019;**13**(3):270–6.
20. Rickards LD. The effectiveness of non-invasive treatments for active myofascial trigger point pain: A systematic review of the literature. *Int J Osteopath Med.* 2006;**9**(4):120–36.

21. Benjaboonyanupap D, Paungmali A, Pirunsan U. Effect of Therapeutic Sequence of Hot Pack and Ultrasound on Physiological Response Over Trigger Point of Upper Trapezius. *Asian J Sports Med [Internet]*. 2015 [cited 2023 Mar 10];**6**(3):57–61. Available from: /pmc/articles/PMC4594134/

22. Dissanayaka TD, Pallegama RW, Suraweera HJ, Johnson MI, Kariyawasam AP. Comparison of the effectiveness of transcutaneous electrical nerve stimulation and interferential therapy on the upper trapezius in myofascial pain syndrome: A randomized controlled study. *Am J Phys Med Rehabil [Internet*]. 2016 [cited 2023 Mar 10];**95**(9):663–72. Available from: https://journals.lww.com/ajpmr/Fulltext/2016/09000/Comparison_of_the_Effectiveness_of_Transcutaneous.4.aspx

23. Manca A, Limonta E, Pilurzi G, Ginatempo F, De Natale ER, Mercante B, et al. Ultrasound and laser as stand-alone therapies for myofascial trigger points: a randomized, double-blind, placebo-controlled study. *Physiother Res Int [Internet]*. 2014 [cited 2022 Jul 14];**19**(3):166–75. Available from: https://pubmed.ncbi.nlm.nih.gov/24382836/

24. Kannan P. Management of myofascial pain of upper trapezius: a three group comparison study. *Glob J Health Sci [Internet]*. 2012 [cited 2022 Jul 14];**4**(5):46–52. Available from: https://pubmed.ncbi.nlm.nih.gov/22980377/

25. Dundar U, Evcik D, Samli F, Pusak H, Kavuncu V. The effect of gallium arsenide aluminum laser therapy in the management of cervical myofascial pain syndrome: A double blind, placebo-controlled study. *Clin Rheumatol [Internet]*. 2007 [cited 2023 Mar 10];**26**(6):930–4. Available from: https://link.springer.com/article/10.1007/s10067-006-0438-4

26. Sharma S, Gupta N, Joshi S, Bala R, Sharma R. Efficacy of Cyriax Physiotherapy versus Cyriax and low level Laser Therapy on pain and grip strength in Lateral Epicondylitis. *Bangladesh J Med Sci [Internet]*. 2021 [cited 2023 Sep 5];**20**(2):356–60. Available from: https://www.banglajol.info/index.php/BJMS/article/view/51548